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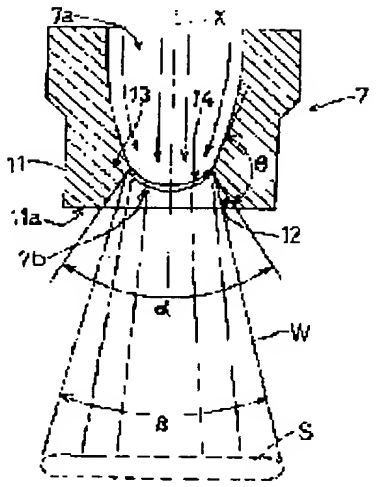
(54) DESCALING NOZZLE

(57)Abstract:
PROBLEM TO BE SOLVED: To efficiently prevent the early damage to the periphery of an orifice resulting from the lowering of its impact resistance while the wear resistance of the periphery to superhigh-pressure water is enhanced.
SOLUTION: A liq. passage 7a with the diameter decreased gradually toward the downstream side in the liq. injecting direction and an orifice 7b with the inlet side communicated with the downstream side of the liq. passage in the liq. injecting direction and having a long-slit shape when seen from the liq. injecting direction are formed in the nozzle main body 7 made of a sintered hard alloy. A concaved part 12 with the diameter gradually decreased toward the upstream side in the liq. injecting direction is formed in the tip part 11 of the main body, and the tip part is integrally formed into a ring surrounding the entire periphery of the concaved part. The entire periphery of the orifice outlet side is opened on the bottom side of the concaved part, and a high- pressure liq. W injected from the orifice is collided with the surface of a material to remove the scale on the material surface.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] Liquid passage (7a) of a minor diameter and an entrance side open the direction lower part side of fluid injection for free passage to the direction lower part side of fluid injection of said liquid passage (7a). A long hole-like orifice (7b) is formed in a nozzle body made from cemented carbide (7) by fluid injection directional vision. A high-pressure liquid (W) injected from said orifice (7b) is made to collide with a surface of metal. Are the nozzle for descaling which removes a scale of the surface of metal concerned, and the direction of fluid injection more nearly superior side forms the concave surface section (12) of a minor diameter in a part for the direction point of fluid injection of said nozzle body (7) (11). A nozzle for descaling prepared in the condition that the amount of (11) point concerned covers the perimeter, and it surrounds a periphery side of said concave surface section (12) and of it really being formed annularly, and an outlet side of said orifice (7b) covering the perimeter, and carrying out a opening to a pars-basilaris-ossis-occipitalis side of said concave surface section (12).
[Claim 2] A nozzle for descaling according to claim 1 whose (HRA(s)) are 94.0 or more cemented carbide in the Rockwell hardness according to A scale of a test method in the Rockwell hardness which said cemented carbide specifies to JIS.
[Claim 3] Said concave surface section (12) is a nozzle for descaling according to claim 1 or 2 currently formed in the condition of not contacting a high-pressure liquid (W) injected from said orifice (7b).
[Claim 4] A nozzle for descaling according to claim 1, 2, or 3 which covers an entrance side and an outlet side of the orifice (7b) concerned and by which inner skin (14) parallel to an orifice axis (X) is formed in the inner circumference section of said orifice (7b).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] A long hole-like orifice is formed in the nozzle body made from cemented carbide by the fluid injection directional vision which an entrance side opens for free passage to the direction lower part side of fluid injection of said liquid passage, and this invention makes the high-pressure liquid injected from said orifice collide with the liquid passage of a minor diameter to a surface of metal like the direction lower part side of fluid injection, and relates to the nozzle for descaling which removes the scale of the surface of metal concerned.
[0002]
[Description of the Prior Art] Although the nozzle for account descaling of ** has a request to use in recent years, making inject the extra-high voltage water whose pressure is a 30 - 100MPa degree in order to raise the descaling engine performance Since wear of the orifice periphery by the high-pressure water contacting the orifice periphery of a nozzle body is promoted so that the pressure of high-pressure water increases, in order to fill such a request, it is necessary to lessen wear of an orifice periphery as much as possible, and to raise the endurance. Since the detailed scale etc. is mixed in the high-pressure underwater especially when collecting the injected high-pressure water and carrying out repeat use, wear will be further promoted by the detailed scale etc. Then, although it considers raising further the degree of hardness of the cemented carbide which forms the nozzle body rather than before, and raising the abrasion resistance of an orifice periphery, when forming a nozzle body for example, by the carbide system cemented carbide which used the tungsten as the principal component, if a degree of hardness is raised, the toughness will fall, shock resistance will be spoiled, and chip-coming to be easy is known (for example, refer to JP,4-348873,A). however, with the conventional nozzle for descaling In the condition of making the point of the nozzle tip 01 which is a nozzle body intersecting the direction lower part side of high-pressure water injection of the high-pressure water outflow passage 02 as shown in drawing 12 - drawing 14 Form the cross-section [of U characters]-like long slot 03, and the long hole-like orifice 04 is formed in the intersection of the high-pressure water outflow passage 02 and long slot 03 by high-pressure water-injection directional vision. A part for the knife-edge-like thin-walled part 06 is formed in the orifice major-axis direction portion formed in long slot 03 pars basilaris ossis occipitalis of the orifice peripheries 05 (for example, refer to JP,1-111464,A).
[0003]
[Problem(s) to be Solved by the Invention] When extra-high voltage water with a pressure higher than before is injected for this reason, there is a defect which cannot improve the endurance of the orifice periphery 05 -- wear out or the amount of [06] that thin-walled part tends to be missing, as the alternate long and short dash line in drawing 13 shows, the orifice periphery 05 is damaged at an early stage, the configuration of an orifice 04 deforms, the injection pressure of extra-high voltage water declines, and it becomes impossible to remove a scale efficiently etc.. Especially when injecting extra-high voltage water which the detailed scale etc. is mixing, the detailed scale collides with a part for the thin-walled part 06, and there is a defect which is much more easy to be missing. Moreover, in descaling of a rolling metal, the plurality of the nozzle for descaling is put in order and used in many cases, the extra-high voltage water injected from the nozzle for descaling rebounds along with long slot 03 longitudinal direction of another nozzle for descaling, and there is a defect which is easy to damage the orifice periphery 05 at an early stage also by colliding with a part for the thin-walled part 06 of the nozzle tip 01. It aims at enabling it to prevent effectively early failure of the orifice periphery accompanying the shock-proof fall by this invention having raised the abrasion resistance for the abrasion resistance of the orifice periphery to extra-high voltage water with slight height by being made in view of the above-mentioned actual

condition, and devising the configuration of an orifice periphery.
[0004]
[Means for Solving the Problem] A nozzle for descaling according to claim 1 like the direction lower part side of fluid injection Liquid passage of a minor diameter, A long hole-like orifice is formed in a nozzle body made from cemented carbide by fluid injection directional vision which an entrance side opens for free passage to the direction lower part side of fluid injection of said liquid passage. It is the nozzle for descaling which a high-pressure liquid injected from said orifice is made to collide with a surface of metal, and removes a scale of the surface of metal concerned. The direction of fluid injection more nearly superior side forms the concave surface section of a minor diameter in a part for the direction point of fluid injection of said nozzle body. Since it is prepared in the condition that the amount of point concerned covers the perimeter, and it surrounds a periphery side of said concave surface section and of it really being formed annularly, and an outlet side of said orifice covering the perimeter, and carrying out a opening to a pars-basilaris-ossis-occipitalis side of said concave surface section As shown in drawing 4 and drawing 6 , the angle theta whose orifice periphery 13 is pinched by the concave surface section 12 and inside of liquid passage 7a covers the perimeter of orifice 7b and is large. While being able to continue and carry out [heavy-gage]-izing of the thickness in the direction of fluid injection of the orifice periphery 13 to the perimeter of orifice 7b There are few possibilities that high-pressure water which an outlet side of orifice 7b covers the perimeter, is surrounded rather than the outlet side by part for the annular point 11 which projects in the direction tip side of fluid injection, was injected from another nozzle for descaling, and rebounded may collide with an outlet side of orifice 7b. Therefore, early failure of the orifice periphery accompanying a shock-proof fall by having raised a degree of hardness of cemented carbide which forms a nozzle body, and having raised a degree of hardness of the cemented carbide for the abrasion resistance of an orifice periphery to extra-high voltage water with slight height can be prevented effectively.
[0005] Since (HRA(s)) are 94.0 or more cemented carbide in the Rockwell hardness according to A scale of a test method in the Rockwell hardness which said cemented carbide specifies to JIS, a nozzle for descaling according to claim 2 can prevent early failure of an orifice periphery much more effectively. That is, (HRA) manufactures a nozzle body of this invention configuration in the Rockwell hardness in each of the cemented carbide A of 88.7, the cemented carbide B of 90.7, and the cemented carbide C of 94.0. About a nozzle for descaling equipped with each of those nozzle bodies When pumping pressure force carries out fixed time amount (about five weeks) injection of the high-pressure water of 15.7MHa(s) on the same conditions and measures the rate of increase of a flow rate accompanying failure of the orifice periphery, as shown in drawing 9 As opposed to a thing with the very large rate of increase at the time of equipping a cemented carbide A list with a nozzle body manufactured by cemented carbide B Since the rate of increase becomes still smaller so that the rate of increase at the time of equipping with a nozzle body manufactured by cemented carbide C is very small and (HRA) moreover increases exceeding 94.0 in the Rockwell hardness If (HRA(s)) are 94.0 or more cemented carbide in the Rockwell hardness, early failure of an orifice periphery can be prevented much more effectively.
[0006] Since an injection pattern of a high-pressure liquid does not change with configuration change of the concave surface section while being hard to generate wear and a chip of the concave surface section, since it is formed in the condition that a nozzle for descaling according to claim 3 does not contact a high-pressure liquid with which said concave surface section is injected from said orifice, it is easy to maintain the injection pattern to a predetermined pattern.
[0007] Since an entrance side and an outlet side of the orifice concerned are covered and inner skin parallel to an orifice axis is formed in the inner circumference section of said orifice, a nozzle for descaling according to claim 4 As shown in drawing 4 and drawing 6 , while being able to carry out [heavy-gage]-izing of the thickness in the direction of fluid injection of the orifice periphery 13 further As shown in drawing 5 , the entrance-side corner 15 and the outlet side corner 16 of the orifice periphery 13 can be formed in an obtuse angle, reinforcement of the orifice periphery 13 is raised, and the early failure can be prevented much more effectively
[0008]
[Embodiment of the Invention]
The [1st operation gestalt] On the steel plate surface under rolling as a surface of metal, as shown in drawing 4 drawing 1 the high-pressure water W whose pumping pressure force as a high-pressure liquid is 15 - 60MPa degree Make it inject with the band-like spray pattern S with thin thickness, and the descaling equipment with which the nozzle 1 for descaling which removes the scale on the surface of a steel plate is being fixed to the adapter P2 is shown. The nozzle 1 for descaling is equipped with the tubed passage formation member 2, the filter 3 which carried out screwing wearing at the end side of the passage formation member 2, and the injection passage formation member 4 which carried out screwing wearing at the other end side of the passage formation

member 2.
[0009] Drawing passage 2b which stands in a row in its rectification way 2a [by which said passage formation member 2 is equipped with the rectifier 5], and lower part side is formed in the shape of the said heart. The injection passage formation member 4 While pressing fit the nozzle tip 7 made from carbide system cemented carbide which used the tungsten as a nozzle body as the principal component inside the nozzle case 6 in the shape of the said heart It equips with a bush 9 between a nozzle tip 7 and the passage formation member 2, and it constitutes so that the injection passage 8 which stands in a row the drawing passage 2b and in the shape of the said heart in the downstream of drawing passage 2b may be formed.
[0010] And the nozzle 1 for descaling is inserted in the condition of making a filter 3 entering in the initiative pipe P1, into the adapter P2 attached in the initiative pipe P1 in the shape of a branch pipe. While inserting packing between flange 6a of the nozzle case 6, and adapter P2 edge, the nozzle case 6 is bound tight to an adapter P2 side with a cap nut 10, it fixes, and the nozzle 1 for descaling concerned is fixed to the initiative pipe P1 side.
[0011] (HRA) is the product made from cemented carbide of abbreviation 94.0 in the Rockwell hardness according to A scale of a test method in the Rockwell hardness which specifies said nozzle tip 7 to JIS (Japanese Industrial Standards). As shown in drawing 2 , the direction lower part side of high-pressure water injection who forms the downstream of the injection passage 8 High-pressure water outflow passage 7a of a minor diameter, Long hole-like (ellipse form) orifice 7b is formed by the high-pressure water-injection directional vision which an entrance side opens for free passage to the direction lower part side of high-pressure water injection of high-pressure water outflow passage 7a, and the high-pressure water W injected from this orifice 7b is made to collide with the steel plate surface, and it constitutes so that the scale on the surface of a steel plate concerned may be removed.
[0012] And as shown in drawing 3 - drawing 6 , flat side 11a which intersects perpendicularly with the direction of high-pressure water injection is formed in a part for the direction point 11 of high-pressure water injection of a nozzle tip 7. The direction of high-pressure water injection more nearly superior side forms the concave surface section 12 of the shape of a earthenware mortar of a minor diameter in the center section of this flat side 11a by high-pressure water-injection directional vision at an ellipse form. It is really formed in annular [to which the amount of / 11 / point concerned covers the perimeter, and it surrounds the periphery side of the concave surface section 12]. It prepares in the condition of covering the perimeter and carrying out the opening of the outlet side of orifice 7b to the pars-basilaris-ossis-occipitalis side of the concave surface section 12, and the perimeter of orifice 7b is covered and the thickness in the direction of high-pressure water injection of the orifice periphery 13 is made heavy-gage.
[0013] Moreover, the inner circumference section of orifice 7b is covered at the entrance side and outlet side of the orifice 7b concerned, and it is narrow [parallel to the orifice axis X] (in the example). While continuing and forming the about 0.2mm inner skin 14 in the perimeter of orifice 7b, the aperture angle alpha of the concave surface section 12 is formed in 60 degrees of abbreviation, and it is made for the high-pressure water W injected by beta whenever [about 27-degree spray angle] from orifice 7b to have not contacted the concave surface section 12.
[0014] The nozzle for descaling which equipped with the nozzle tip 01 of a configuration conventionally which shows drawing 7 to drawing 12 , The nozzle for descaling equipped with the nozzle tip 7 of this invention configuration is manufactured so that beta may become the same whenever [those flow rate and spray angle]. The pumping pressure force about the cases of 14.7MPa(s), 29.4MPa, 49.0MPa, and 62.8MPa It turns out that the pressure-receiving sensor Q shows the result of having measured distribution of the collision force as shown in drawing 8 , and there is no big difference in the collision force distribution by the nozzle tip 01 of a configuration, and the collision force distribution by the nozzle tip 7 of this invention configuration conventionally.
[0015] Moreover, as for drawing 9 , (HRA) manufactures the nozzle body of this invention configuration in the Rockwell hardness in each of the cemented carbide A of 88.7, the cemented carbide B of 90.7, and the cemented carbide C of 94.0. About the nozzle for descaling equipped with each of those nozzle bodies The time of the pumping pressure force carrying out fixed time amount (about five weeks) injection of the high-pressure water of 15.7MPa(s) on the same conditions, It turns out that the rate of increase at the time of equipping with the nozzle body manufactured by cemented carbide C to a thing with the very large rate of increase at the time of equipping with the nozzle body which shows the rate of increase of the flow rate accompanying failure of the orifice 7b by percentage, and was manufactured by cemented carbide B in the cemented carbide A list is very small.

[0016] The [2nd operation gestal[redacted]awing 10 and drawing 11 show the ope[redacted]n gestalt which does not form in the inner circumference section of orifice 7b the inner skin 14 parallel to the orifice axis X shown with the 1st operation gestalt, and other configurations are the same as that of the 1st operation gestalt.

[0017] [Other operation gestalten]

1. The concave surface section may be formed in the shape of [so-called] a trumpet.
2. The entrance side and outlet side of the orifice concerned are covered, and inner skin parallel to an orifice axis may be formed in a part of inner circumference section of an orifice.
3. The concave surface section contacts the high-pressure liquid injected from an orifice, and may be formed in the condition of regulating the injection direction.

[0018] In addition, although a sign is described in order to make contrast with a drawing convenient at the term of a claim, this invention is not limited to the configuration of an accompanying drawing by this entry.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The cross section of the nozzle equipment for descaling
[Drawing 2] The perspective diagram of a nozzle tip
[Drawing 3] Front view of a nozzle tip
[Drawing 4] The IV-IV line view cross section of drawing 3
[Drawing 5] Drawing 4 is an enlarged view a part.
[Drawing 6] The VI-VI line view cross section of drawing 3
[Drawing 7] The graph which compares collision force distribution
[Drawing 8] The important section perspective diagram showing the measurement method of collision force distribution
[Drawing 9] The graph which shows the relation between the hardness of cemented carbide, and the flow rate rate of increase
[Drawing 10] The important section cross section showing the 2nd operation gestalt
[Drawing 11] Drawing 10 is an enlarged view a part.
[Drawing 12] The perspective diagram of the conventional nozzle tip
[Drawing 13] Front view of the conventional nozzle tip
[Drawing 14] The XIV-XIV line view cross section of drawing 13
[Description of Notations]
7 Nozzle Body
7a Liquid passage
7b Orifice
11 A Part for Point
12 Concave Surface Section
14 Inner Skin
W High-pressure liquid
X Orifice axis

[Translation done.]

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審査請求　未請求　請求項の数４　ＯＬ　（全５頁）

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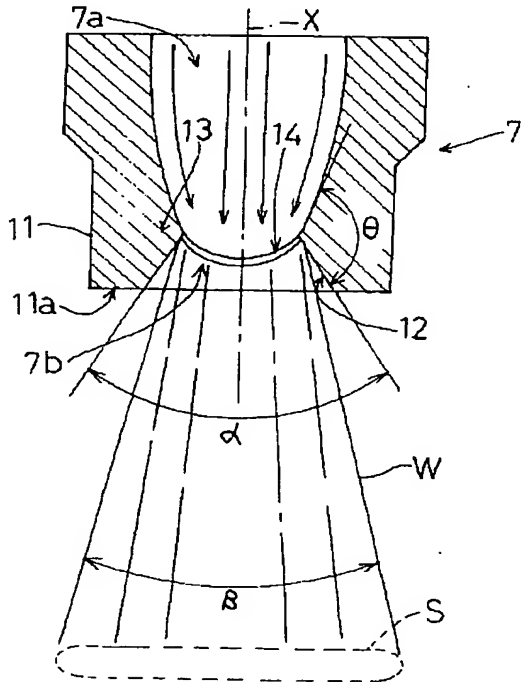
(54)【発明の名称】　スケール除去用ノズル

(57)【要約】
【課題】　超高圧水に対するオリフィス周部の耐磨耗性を高めながら、その耐磨耗性を高めたことによる耐衝撃性の低下にともなう、そのオリフィス周部の早期破損を効果的に防止できるようにする。
【解決手段】　液体噴射方向下手側ほど小径の液体流路７ａと、入口側が液体流路の液体噴射方向下手側に連通する液体噴射方向視で長孔状のオリフィス７ｂとを超硬合金製のノズル本体７に形成し、ノズル本体の液体噴射方向先端部分１１に液体噴射方向上手側ほど小径の凹面部１２を形成して、当該先端部分を、凹面部の外周側をその全周に亘って囲む環状に一体形成し、オリフィスの出口側を、その全周に亘って凹面部の底部側に開口する状態で設け、オリフィスから噴射した高圧液体Ｗを金属表面に衝突させて、当該金属表面のスケールを除去する。



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【特許請求の範囲】

【請求項１】　液体噴射方向下手側ほど小径の液体流路（７ａ）と、

入口側が前記液体流路（７ａ）の液体噴射方向下手側に連通する、液体噴射方向視で長孔状のオリフィス（７ｂ）とが超硬合金製のノズル本体（７）に形成され、

前記オリフィス（７ｂ）から噴射した高圧液体（Ｗ）を金属表面に衝突させて、当該金属表面のスケールを除去するスケール除去用ノズルであって、

前記ノズル本体（７）の液体噴射方向先端部分（１１）に液体噴射方向上手側ほど小径の凹面部（１２）を形成して、当該先端部分（１１）が、前記凹面部（１２）の外周側をその全周に亘って囲む環状に一体形成され、

前記オリフィス（７ｂ）の出口側が、その全周に亘って前記凹面部（１２）の底部側に開口する状態で設けられているスケール除去用ノズル。

【請求項２】　前記超硬合金が、ＪＩＳ規格に規定するロックウェル硬さ試験方法のＡスケールによるロックウェル硬さ（ＨＲＡ）が９４．０以上の超硬合金である請求項１記載のスケール除去用ノズル。

【請求項３】　前記凹面部（１２）は、前記オリフィス（７ｂ）から噴射される高圧液体（Ｗ）に接触しない状態に形成されている請求項１又は２記載のスケール除去用ノズル。

【請求項４】　前記オリフィス（７ｂ）の内周部に、当該オリフィス（７ｂ）の入口側と出口側とに亘ってオリフィス軸芯（Ｘ）と平行な内周面（１４）が形成されている請求項１，２又は３記載のスケール除去用ノズル。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、液体噴射方向下手側ほど小径の液体流路と、入口側が前記液体流路の液体噴射方向下手側に連通する、液体噴射方向視で長孔状のオリフィスとが超硬合金製のノズル本体に形成され、前記オリフィスから噴射した高圧液体を金属表面に衝突させて、当該金属表面のスケールを除去するスケール除去用ノズルに関する。

【０００２】

【従来の技術】冒記スケール除去用ノズルは、スケール除去性能を高める為に、近年において、圧力が３０～１００ＭＰａ程度の超高圧水を噴射させて使用したい要望があるが、高圧水の圧力が増大する程、その高圧水がノズル本体のオリフィス周部に接触することによるオリフィス周部の磨耗が促進されるから、そのような要望を満たす為には、オリフィス周部の磨耗をできるだけ少なくしてその耐久性を高める必要がある。特に、噴射した高圧水を回収して繰り返し使用する場合はその高圧水中に微細なスケール等が混入しているから、その微細なスケール等によって磨耗が一層促進されることになる。そこで、ノズル本体を形成している超硬合金の硬度を従来よりも一層高めて、オリフィス周部の耐磨耗性を高めることが考えられているが、例えば、タングステンを主成分とした炭化物系超硬合金でノズル本体を形成する場合、硬度を高めるとその靭性が低下して耐衝撃性が損なわれ、欠け易くなることが知られている（例えば、特開平４－３４８８７３号公報参照）。ところが、従来のスケール除去用ノズルでは、図１２～図１４に示すように、ノズル本体であるノズルチップ０１の先端部に、高圧水流出流路０２の高圧水噴射方向下手側に交差させる状態で、断面Ｕ字状の長溝０３を形成して、その高圧水流出流路０２と長溝０３との交差部に高圧水噴射方向視で長孔状のオリフィス０４を形成しており、オリフィス周部０５のうちの長溝０３底部に形成されるオリフィス長径方向部分にはナイフエッジ状の薄肉部分０６が形成されている（例えば、特開平１－１１１４６４号公報参照）。

2

【０００３】

【発明が解決しようとする課題】この為、従来よりも圧力が高い超高圧水を噴射すると、その薄肉部分０６が、図１３中の一点鎖線で示すように、磨耗したり欠け易く、オリフィス周部０５が早期に破損してオリフィス０４の形状が変形し、超高圧水の噴射圧力が低下してスケールを効率よく除去できなくなる等、オリフィス周部０５の耐久性を向上できない欠点がある。特に、微細なスケール等が混入しているような超高圧水を噴射する場合は、その微細なスケールがその薄肉部分０６に衝突して、一層欠け易い欠点がある。また、圧延金属のスケール除去においては、スケール除去用ノズルの複数を並べて使用することが多く、スケール除去用ノズルから噴射した超高圧水が別のスケール除去用ノズルの長溝０３長手方向に沿って跳ね返って、そのノズルチップ０１の薄肉部分０６に衝突することによっても、オリフィス周部０５を早期に破損し易い欠点がある。本発明は上記実情に鑑みてなされたものであって、オリフィス周部の形状を工夫することにより、超高圧水に対するオリフィス周部の耐磨耗性を高めながら、その耐磨耗性を高めたことによる耐衝撃性の低下にともなう、そのオリフィス周部の早期破損を効果的に防止できるようにすることを目的とする。

【０００４】

【課題を解決するための手段】請求項１記載のスケール除去用ノズルは、液体噴射方向下手側ほど小径の液体流路と、入口側が前記液体流路の液体噴射方向下手側に連通する、液体噴射方向視で長孔状のオリフィスとが超硬合金製のノズル本体に形成され、前記オリフィスから噴射した高圧液体を金属表面に衝突させて、当該金属表面のスケールを除去するスケール除去用ノズルであって、前記ノズル本体の液体噴射方向先端部分に液体噴射方向上手側ほど小径の凹面部を形成して、当該先端部分が、前記凹面部の外周側をその全周に亘って囲む環状に一体

形成され、前記オリフィスの出口側が、その全周に亘って前記凹面部の底部側に開口する状態で設けられているので、図４，図６に示すように、凹面部１２と液体流路７ａの内面とでオリフィス周部１３を挟む角度θがオリフィス７ｂの全周に亘って大きく、オリフィス周部１３の液体噴射方向での厚みをオリフィス７ｂの全周に亘って厚肉化できるとともに、オリフィス７ｂの出口側がその出口側よりも液体噴射方向先端側に突出する環状の先端部分１１で全周に亘って囲まれており、別のスケール除去用ノズルから噴射されて跳ね返った高圧水がオリフィス７ｂの出口側に衝突するおそれが少ない。従って、ノズル本体を形成している超硬合金の硬度を高めて超高圧水に対するオリフィス周部の耐磨耗性を高めながら、その超硬合金の硬度を高めたことによる耐衝撃性の低下にともなう、そのオリフィス周部の早期破損を効果的に防止できる。

【０００５】請求項２記載のスケール除去用ノズルは、前記超硬合金が、ＪＩＳ規格に規定するロックウェル硬さ試験方法のＡスケールによるロックウェル硬さ（ＨＲＡ）が９４．０以上の超硬合金であるので、オリフィス周部の早期破損を一層効果的に防止できる。つまり、ロックウェル硬さ（ＨＲＡ）が８８．７の超硬合金Ａと９０．７の超硬合金Ｂと９４．０の超硬合金Ｃの各々で本発明形状のノズル本体を製作し、それらのノズル本体の各々を装着したスケール除去用ノズルについて、ポンプ圧力が１５．７ＭＨａの高圧水を同一条件で一定時間（約５週間）噴射させて、そのオリフィス周部の破損に伴う流量の増加率を計測したところ、図９に示すように、超硬合金Ａ並びに超硬合金Ｂで製作したノズル本体を装着した場合の増加率が極めて大きいのに対して、超硬合金Ｃで製作したノズル本体を装着した場合の増加率が極めて小さく、しかも、ロックウェル硬さ（ＨＲＡ）が９４．０を越えて増加するほどその増加率が一層小さくなるので、ロックウェル硬さ（ＨＲＡ）が９４．０以上の超硬合金であれば、オリフィス周部の早期破損を一層効果的に防止できるのである。

【０００６】請求項３記載のスケール除去用ノズルは、前記凹面部は、前記オリフィスから噴射される高圧液体に接触しない状態に形成されているので、凹面部の磨耗や欠けが発生しにくいとともに、高圧液体の噴射パターンが凹面部の形状変化に伴って変化することがないので、その噴射パターンを所定パターンに維持し易い。

【０００７】請求項４記載のスケール除去用ノズルは、前記オリフィスの内周部に、当該オリフィスの入口側と出口側とに亘ってオリフィス軸芯と平行な内周面が形成されているので、図４，図６に示すように、オリフィス周部１３の液体噴射方向での厚みを一層厚肉化できるとともに、図５に示すように、オリフィス周部１３の入口側角部１５と出口側角部１６とを鈍角に形成でき、オリフィス周部１３の強度を高めてその早期破損を一層効果的に防止できる。

【０００８】

【発明の実施の形態】

〔第１実施形態〕図１は、金属表面としての圧延中の鋼板表面に高圧液体としてのポンプ圧力が１５～６０ＭＰａ程度の高圧水Ｗを、図４に示すように、厚みの薄い帯状のスプレーパターンＳで噴射させて、その鋼板表面のスケールを除去するスケール除去用ノズル１がアダプタＰ２に固定されているスケール除去装置を示し、スケール除去用ノズル１は、筒状の流路形成部材２と、流路形成部材２の一端側に螺合装着したフィルタ３と、流路形成部材２の他端側に螺合装着した噴射流路形成部材４とを備えている。

【０００９】前記流路形成部材２には、整流器５が装着されている整流路２ａとその下手側に連なる絞り流路２ｂとが同芯状に形成され、噴射流路形成部材４は、ノズルケース６の内側にノズル本体としてのタングステンを主成分とした炭化物系超硬合金製のノズルチップ７を同芯状に圧入するとともに、ノズルチップ７と流路形成部材２との間にブッシュ９を装着して、絞り流路２ｂの下流側にその絞り流路２ｂと同芯状に連なる噴射流路８を形成するように構成してある。

【００１０】そして、主導管Ｐ１に枝管状に取り付けたアダプタＰ２内に、フィルタ３を主導管Ｐ１内に入り込ませる状態でスケール除去用ノズル１を挿入し、ノズルケース６のフランジ部６ａとアダプタＰ２端部との間にパッキンを挟むとともに、ノズルケース６を袋ナット１０でアダプタＰ２側に締め付け固定して、当該スケール除去用ノズル１を主導管Ｐ１側に固定してある。

【００１１】前記ノズルチップ７は、ＪＩＳ規格（日本工業規格）に規定するロックウェル硬さ試験方法のＡスケールによるロックウェル硬さ（ＨＲＡ）が略９４．０の超硬合金製で、図２に示すように、噴射流路８の下流側を形成する高圧水噴射方向下手側ほど小径の高圧水流出流路７ａと、入口側が高圧水流出流路７ａの高圧水噴射方向下手側に連通する、高圧水噴射方向視で長孔状（楕円形）のオリフィス７ｂとが形成され、このオリフィス７ｂから噴射した高圧水Ｗを鋼板表面に衝突させて、当該鋼板表面のスケールを除去するように構成してある。

【００１２】そして、図３～図６に示すように、ノズルチップ７の高圧水噴射方向先端部分１１に高圧水噴射方向と直交する扁平面１１ａを形成し、この扁平面１１ａの中央部に高圧水噴射方向上手側ほど小径のすり鉢状の凹面部１２を高圧水噴射方向視で楕円形に形成して、当該先端部分１１が、凹面部１２の外周側をその全周に亘って囲む環状に一体形成され、オリフィス７ｂの出口側をその全周に亘って凹面部１２の底部側に開口させる状態で設けて、オリフィス周部１３の高圧水噴射方向での厚みをオリフィス７ｂの全周に亘って厚肉化してある。

【００１３】また、オリフィス７ｂの内周部に、当該オリフィス７ｂの入口側と出口側とに亘ってオリフィス軸芯Ｘと平行な幅狭（実施例では、０．２ｍｍ程度）の内周面１４をオリフィス７ｂの全周に亘って形成するとともに、凹面部１２の開き角度αを略６０°に形成して、オリフィス７ｂから約２７°の噴射角度βで噴射される高圧水Ｗがその凹面部１２に接触しないようにしてある。

【００１４】図７は、図１２に示す従来形状のノズルチップ０１を装着したスケール除去用ノズルと、本発明形状のノズルチップ７を装着したスケール除去用ノズルとをそれらの流量と噴射角度βが同一になるように製作して、ポンプ圧力が１４．７ＭＰａ，２９．４ＭＰａ，４９．０ＭＰａ，６２．８ＭＰａの各々の場合について、受圧センサーＱで図８に示すように衝突力の分布を計測した結果を示し、従来形状のノズルチップ０１による衝突力分布と、本発明形状のノズルチップ７による衝突力分布とに大きな差異がないことがわかる。

【００１５】また、図９は、ロックウェル硬さ（ＨＲＡ）が８８．７の超硬合金Ａと９０．７の超硬合金Ｂと９４．０の超硬合金Ｃの各々で本発明形状のノズル本体を製作し、それらのノズル本体の各々を装着したスケール除去用ノズルについて、ポンプ圧力が１５．７ＭＰａの高圧水を同一条件で一定時間（約５週間）噴射させたときの、そのオリフィス７ｂの破損に伴う流量の増加率を百分率で示しており、超硬合金Ａ並びに超硬合金Ｂで製作したノズル本体を装着した場合の増加率が極めて大きいのに対して、超硬合金Ｃで製作したノズル本体を装着した場合の増加率が極めて小さいことがわかる。

【００１６】〔第２実施形態〕図１０，図１１は、オリフィス７ｂの内周部に、第１実施形態で示したオリフィス軸芯Ｘと平行な内周面１４を形成していない実施形態を示し、その他の構成は第１実施形態と同様である。

【００１７】〔その他の実施形態〕

１．凹面部は、いわゆるラッパ状に形成されていても良＊い。

２．オリフィスの内周部の一部に、当該オリフィスの入口側と出口側とに亘ってオリフィス軸芯と平行な内周面が形成されていても良い。

３．凹面部は、オリフィスから噴射される高圧液体に接触して、その噴射方向を規制する状態に形成されていても良い。

【００１８】尚、特許請求の範囲の項に図面との対照を便利にするために符号を記すが、該記入により本発明は添付図面の構成に限定されるものではない。

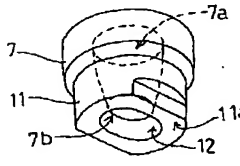
【図面の簡単な説明】

【図１】スケール除去用ノズル装置の断面図
【図２】ノズルチップの斜視図
【図３】ノズルチップの正面図
【図４】図３のＩＶ－ＩＶ線矢視断面図
【図５】図４の一部拡大図
【図６】図３のＶＩ－ＶＩ線矢視断面図
【図７】衝突力分布を比較するグラフ
【図８】衝突力分布の計測方法を示す要部斜視図
【図９】超硬合金の硬さと流量増加率との関係を示すグラフ
【図１０】第２実施形態を示す要部断面図
【図１１】図１０の一部拡大図
【図１２】従来のノズルチップの斜視図
【図１３】従来のノズルチップの正面図
【図１４】図１３のＸＩＶ－ＸＩＶ線矢視断面図

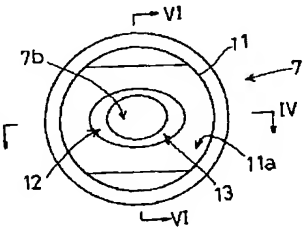
【符号の説明】

７　ノズル本体
７ａ　液体流路
７ｂ　オリフィス
１１　先端部分
１２　凹面部
１４　内周面
Ｗ　高圧液体
Ｘ　オリフィス軸芯

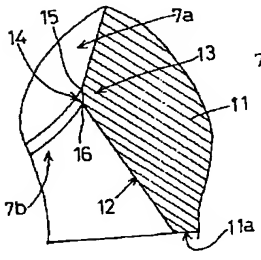
【図２】



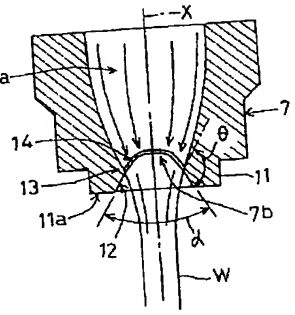
【図３】



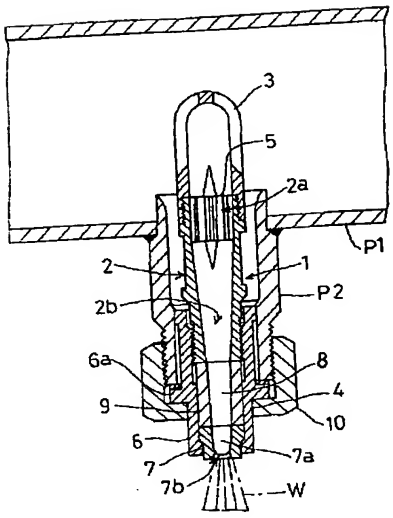
【図５】



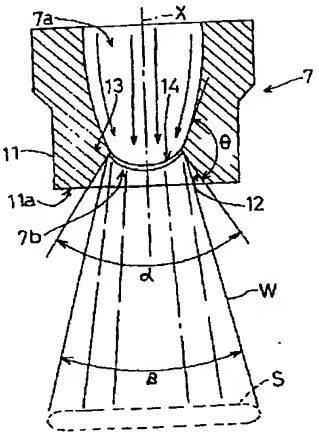
【図６】



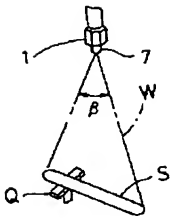
【図１】



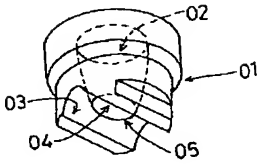
【図４】



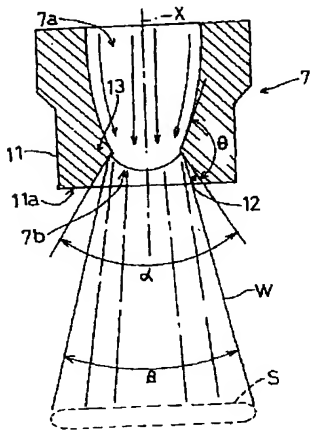
【図８】



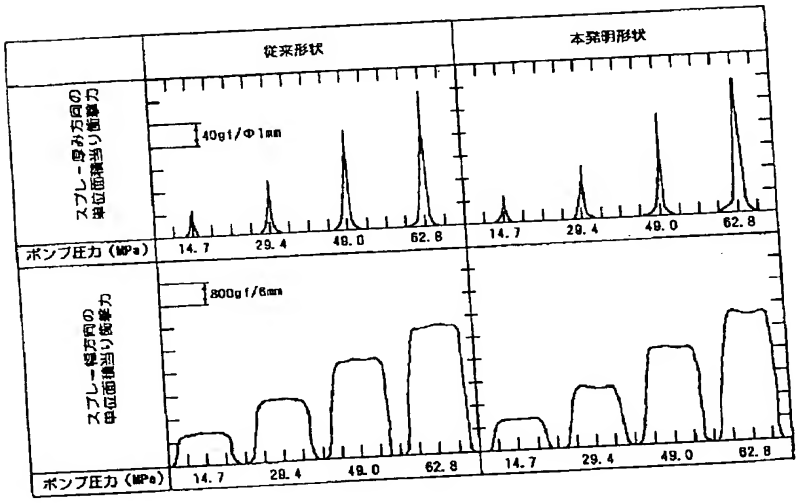
【図１２】



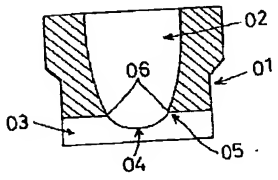
【図１０】



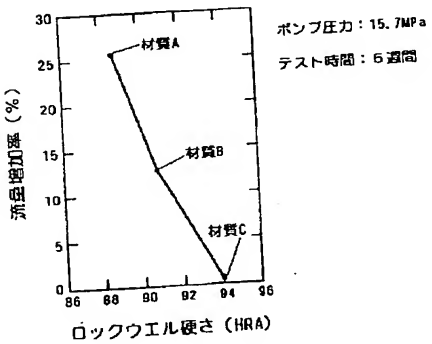
【図７】



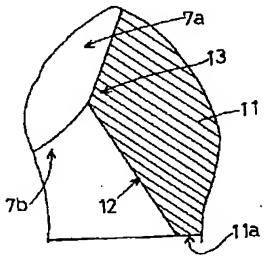
【図１４】



【図９】



【図１１】



【図１３】